

Improved selection of the functional unit in environmental impact assessment of cement

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Abstract

The outcome of Life Cycle Assessment (LCA) studies is strongly influenced by the selection of the functional unit, which must be defined in such a way that, when products are compared, the amounts compared have identical utilities. LCA studies of cements mostly use mass based functional units (MFU). However, since different cements have a different composition and binding capacity, they result in different compressive strength and durability in their applications, so that MFUs are inadequate. Therefore, this study introduces as functional unit the Cement Functional Performance (CFP): mass of cement needed to obtain 1 MPa of compressive strength during one year of durability ($\text{kg}/(\text{MPa}\cdot\text{year})$). To evaluate the effect of the CFP, the environmental performance of three cements is compared. Results show that adding 5% of zeolite to cement results in a similar strength and 1.78 times higher durability of the produced concrete, which is explained by the reduction of chloride diffusion. Moreover, adding 19% of zeolite to cement increases its durability 2.75 times, but reduces compressive strength by 29%. As a result, cement with 5 and 19% of zeolite added has respectively 54 and 36% of the environmental impacts of Portland cement.

Keywords

Life Cycle Assessment, Functional Unit, Cement, Environmental Impact